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(54) Improvements in or relating to key button switches.

(57) A key button structure for a keyboard of a data input device comprises a base plate 1 having an opening 5 defining a switch site for a push button 3 biassed to a raised inoperative position by a resiliently flexible membrane 2 integral with the base plate 1. The base plate 1 has integral legs 4 for securing to a printed circuit board 21 and integral guide posts 6 to locate and retain the push button 3. Single and multi-button assemblies are disclosed.

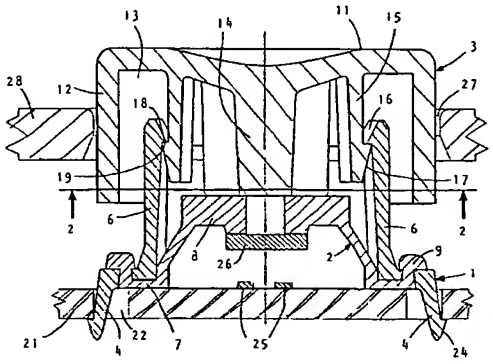

FIGURE 1.

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This invention relates to keyboards for data input devices such as telephones, calculators or the like and in particular, though not exclusively keyboards incorporating a push button switch assembly.

It is an object of the present invention to provide a key button structure for a push button switch assembly of simple construction.

According to the present invention there is provided a key button structure for a switch assembly comprising a base plate having an opening defining a switch site, and a resiliently flexible membrane integral with the base plate and arranged to provide a return spring function for a push button.

Preferably, the base plate has guide means for locating the push button for axial sliding movement towards and away from the base plate.

Conveniently the guide means is positioned around the marginal edge of the opening and extends to one side of the base plate for reception in a recess in the underside of the push button.

Advantageously, the guide means comprises a plurality of guide posts uniformly spaced around the marginal edge of the opening in the base plate.

In a preferred construction, there are four guide posts for location at respective corners of a square recess in the push button to engage adjoining side walls along the outer corner edges of the guide posts.

The push button may be retained in a raised inoperative or rest position under the biassing of the membrane by engagement with the guide means. For example, the push button may have retainer arms engageable with the guide posts. The retainer arms may be releasable for detaching the push button.

Alternatively, the push button may be retained in the raised position under the biassing of the membrane by engagement with a cover or case of the data input device. For example, the push button may extend through an opening in the case for user actuation and be retained by engagement on the underside of the case around the opening.

The base plate may be adapted for securing the key button structure to a circuit board or similar substrate to align a switch device with the opening in the base plate. For example, the base plate may have resilient legs for engagement in aligned apertures in the circuit board. The legs are preferably releasable for detaching the key button structure.

Alternatively, the base plate may be adapted for securing the key button structure to a cover or case of the data input device prior to assembly to a circuit board or the like to align a switch device with the opening in the base plate. For example, the base plate may have resilient tongues for engagement in an opening in the cover or case through which the push button projects for user access.

The switch device may comprise a pair of fixed switch contacts on the circuit board and a movable contact of electrically conductive material secured to the underside of the membrane.

Advantageously, the membrane is arranged to seal the key button structure relative to the circuit board around the opening to protect the switch device from ingress of contaminants.

In a preferred construction, the membrane is of frusto-conical shape having a base seated around the opening on the underside of the base plate and a raised platform at the apex engageable with the push button on the opposite side of the base plate.

Preferably, the base plate has stop means for limiting resiliently depression of the push button to lower the movable contact onto the fixed contacts. The stop means is preferably formed integrally with the membrane to secure non-releasably the membrane and the base plate.

In a preferred construction, the base plate is a moulding of substantially rigid plastics such as polyphenylene sulphide and the membrane is a moulding of elastomer such as silicone rubber which is moulded onto the base plate so as to be permanently secured thereto.

The key button structure may be adapted for one push button by the provision of a single opening in the base plate. Alternatively, the key button structure may be adapted for several push buttons by the provision of a plurality of openings in the base plate with each opening having an associated membrane integral with the base plate.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, wherein:-

FIGURE 1 is a sectional view of a switch assembly incorporating a first embodiment of a key button structure according to the invention;

FIGURE 2 is a section on the line 2-2 of Figure 1;

FIGURE 3 is a plan view of the base plate of the key button structure shown in Figure 1;

FIGURE 4 is a section on the line 4-4 of Figure 3;

FIGURE 5 is a sectional view similar to Figure 1 showing a modified key button structure;

FIGURE 6 is a plan view of the base plate of the key button structure shown in Figure 5;

FIGURE 7 is a sectional view similar to Figure 1 showing another modified key button structure;

FIGURE 8 is a sectional view of a switch assembly incorporating a second embodiment of a key button structure according to the invention; and

FIGURE 9 is a plan view of the base plate and integral membranes of the key button structure shown in Figure 8.

Figures 1 to 4 of the accompanying drawings show a first embodiment of a key button structure in a switch assembly for a data input device such as a telephone keyboard (not shown).

The key button structure comprises a plastics

base plate 1, a resiliently flexible elastomeric membrane 2 and a plastics push button 3.

The base plate 1 is of generally square shape in plan view having a resilient leg 4 depending from each corner and a circular hole 5 at the centre.

Upstanding from the base plate 1 adjacent to each corner are four guide posts 6 uniformly spaced around the marginal edge of the hole 5.

The flexible membrane 2 is of frusto-conical shape having an annular base 7 that seats around the hole 5 in a counterbore 5a on the underside of the base plate 1, and a platform 8 at the apex centrally positioned between the guide posts 6 on the opposite side of the base plate 1.

The membrane 2 is moulded onto the base plate 1 and has formed integrally therewith on the upper surface of the base plate 1 at each corner, four pads 9 connected to the base 7 of the membrane 2 through respective orifices 10 in the base plate 1 to secure non-releasably the membrane 2 and base plate 1.

The button 3 is of square shape in plan view comprised of a top wall 11 and dependent side walls 12 defining a square recess 13 open to the underside in which the guide posts 6 are received.

Each guide post 6 is positioned adjacent to a respective corner of the recess 13 and, as best shown in Figure 2, has radiused outer corner edges 6a engageable with adjoining side walls 12 of the button 3 to locate the button 3 for axial sliding movement relative to the base plate 1 and prevent the button 3 tilting or rocking on the guide posts 6.

The line contact between the corner edges 6a of the guide posts 6 and side walls 12 of the button 1 facilitates axial sliding movement with minimum frictional resistance. Frictional resistance may be further reduced by the selection of the plastics materials for the base plate 1 and button 3.

Depending from the top wall 11 of the button 3 within the recess 13 are a centre post 14 of X-shape in transverse section that seats on the platform 8, and four retainer arms 15 uniformly spaced around the centre post 14 on the inside of the guide posts 6.

The guide posts 6 and retainer arms 15 have opposed internal and external chamfer faces 16 and 17 respectively that extend from the free ends and terminate in respective undercut ledges 18,19.

The chamfer faces 16,17 co-operate to displace the guide posts 6 and retainer arms 15 radially for push fitting the button 3 on the guide posts 6 until the ledges 18,19 engage with a snap action to retain the button 3 on the guide posts 6 in a raised inoperative or rest position under the biassing of the flexible membrane 2.

Cut-outs 20 in the side walls 12 of the button 3 provide access between adjacent guide posts 6 for insertion of a suitable tool (not shown) to release the retainer arms 15 for removing the button 3 if required for repair, replacement, etc.

The key button structure above-described provides a sub-assembly for securing to a flat substrate such as a printed circuit board 21 by inserting the dependent legs 4 of the base plate 1 through aligned apertures 22 in the board 21.

Each leg 4 has a foot 23 with an external ramp face 24 that co-operates with the marginal edge of the aperture 22 to displace the leg 4 radially until the foot 23 engages the underside of the board 21 with a snap action to retain the key button structure on the board 21.

The key button structure may be detached from the board 21 if required for repair, replacement etc by releasing the feet 23 and withdrawing the legs 4 through the apertures 22.

Aligned with the hole 5 in the base plate 1 is a switch device comprising a pair of fixed contacts 25 on the board 21 and a movable contact 26 of electrically conductive material on the underside of the platform 8 that is spaced above the fixed contacts 25 in the inoperative or rest position of the button 3.

The movable contact 26 is lowered to engage and connect electrically the fixed contacts 25 by manual depression of the push button 3 against the biassing of the membrane 2 which provides a spring function to return the button 3 to the inoperative or rest position on releasing the button 3.

The base 7 of the membrane 2 seals the key button structure relative to the board 21 around the hole 5 to protect the switch device from ingress of contaminants, and the pads 9 limit resiliently depression of the button 3 for user comfort and to protect the switch device from excessive user actuation force applied to the push button 3.

The data input device will typically have a plurality of separate key button structures secured to the circuit board 21 as above-described for performing different functions with each button 3 arranged to project through an opening 27 in an outer cover or case 28 for user access. The different functions may be identified by suitable indicia on exposed surfaces of each button 3, for example the top wall 11.

As will be appreciated, the number and position of the key button structures can be adapted for different applications as desired in a simple manner facilitating assembly of a wide range of keyboards having different arrays of buttons using a common key button structure.

Referring now to Figures 5 and 6, a modified key button structure is shown in which like reference numerals are used to indicate parts corresponding to the first embodiment.

The key button structure provides a sub-assembly for securing to the outer cover or case 28 by four resilient tongues 29 upstanding from the marginal edges of the base plate 1 on each side. The tongues 29 are a push fit in and frictionally engage the inner end of the opening 27 in the case 28 to locate and re-

tain the key button structure for subsequent assembly of the case 28 onto the printed circuit board 21.

When assembled, the key button structure is loaded against the board 21 by engagement of the case 28 with the corner pads 9 at the inner end of the opening 27 so that the base 7 of the membrane 2 seals the key button structure relative to the board 21 around the hole 5 and the cut-outs 20 in the side walls of the button 3 provide clearance for the tongues 29 on depression of the button 3 to actuate the switch device.

By securing the key button structure to the case 28, the area of the circuit board 21 that can be utilised for circuit connections is increased as compared with the first embodiment in which the key button structure is secured to the board 21.

Additionally, as shown in Figure 6, the membrane base 7 is arranged to raise the underside of the base plate 1 above the board 21 providing a clearance space 30 in which solder contacts 31 may be arranged thereby increasing further the area for making electrical contacts. This has advantages where available space is limited, for example for manufacture of small size keyboards having a plurality of closely arrayed push buttons.

Another modified key button structure is shown in Figure 7 in which like reference numerals are used to indicate parts corresponding to the first embodiment.

The key button structure is comprised of base plate 1 and membrane 2 releasably secured to the circuit board by the dependent legs 4 of the base plate 1 and the push button 3 is slidably mounted in the opening 27 of the outer case 28. The push button 3 is retained in the raised position under the biassing of the membrane 2 by engagement of an external projection 32 in an axial guide slot 33 in the opening 27.

Referring now to Figures 8 and 9, a switch assembly incorporating a second embodiment of a key button structure is shown in which like reference numerals in the series 100 are used to indicate parts corresponding to the first embodiment.

The base plate 101 has an open grid structure comprised of a square array of sixteen uniformly spaced circular holes 105 defined by ring elements 134 with interconnecting webs 135

Uniformly spaced around the marginal edge of each hole are four guide posts 106 upstanding from the base plate 101 on which a respective push button 103 is located for axial sliding movement.

Each button 103 is of square shape in plan view having a top wall 111 and dependent side walls 112 defining a square recess 113 open to the underside in which the guide posts 106 are received.

Each guide post 106 is positioned adjacent to a corner of the recess 113 and has radiused outer corner edges 106a engageable with adjoining side walls 112 of the button 103 to locate the button 103 for axial sliding movement relative to the base plate 101 and prevent the button 103 tilting or rocking on the guide posts 106.

Each hole 105 is provided with a resiliently flexible elastomeric membrane 102 of frusto-conical shape having an annular base 107 that seats around the hole 105 in a counterbore 105a on the underside of the base plate 101, and a platform 108 at the apex centrally positioned between the guide posts 106 on the oppodite side of the base plate 101.

Each membrane 102 is moulded onto the base plate 101 and has formed integrally therewith on the upper surface of the base plate 101, an annular pad 109 encircling the associated guide posts 106 and connected to the base 107 of the membrane 102 through orifices 110 in the base plate 101 to secure non-releasably the membrane 102 and base plate 101.

Upstanding from the base plate 101 adjacent to each corner are four pillars 136 for locating and securing the base plate 101 to an outer case 128 having a matching array of sixteen openings 127 aligned with the buttons 103.

Each button 103 is retained on the guide posts 106 in a raised inoperative or rest position projecting through the aligned opening 127 under the biassing of the associated membrane 102 by engagement of an external flange 137 with the underside of the case 128 around the opening 127. Alternatively, each button may be retained in the raised position by engagement with the guide posts, for example by retainer arms similar to the first and second embodiments.

The key button structure secured to the case 128 is assembled onto a printed circuit board 121 to align each hole 105 in the base plate 101 with a respective switch device comprising a pair of fixed switch contacts 125 on the board 121 and a movable contact 126 secured to the underside of the platform 108 that is spaced above the fixed contacts 125 in the rest position of the associated button 103.

The switch devices are selectively actuable by depression of the appropriate push button 103 to lower the movable contact 126 onto the fixed contacts 125 against the biassing of the associated membrane 102 which provides a spring function for returning the button to the inoperative position on releasing the button 103.

The key button structure is sealed relative to the board 121 around each hole 105 by the base 107 of the associated membrane to prevent ingress of contaminants and excessive actuation forces are cushioned by engagement of the button 103 with the pad 109 for user comfort and to prevent damage to the switch contacts 125,126.

By using a common base plate for a plurality of buttons, the key button structure can be adapted for different applications by changing the buttons. It will be understood that the number and position of the

openings in the base plate may be altered to provide any desired array of buttons for a given application.

In the above-described embodiments, the base plate 1,101 is conveniently a moulding of substantially rigid plastics such as polyphenylene sulphide onto which the elastomeric membrane(s) 2,102 is/are moulded to form an integral spring unit for the button(s) 3,103. Suitable elastomers for the membrane(s) 2,102 include silicone rubber and each push button 3,103 is conveniently a moulding of substantially rigid plastics such as acrylonitrile butadiene styrene.

It will be understood that the invention is not limited to the embodiments above-described. For example, the actuation portion of each push button may be rectangular or any other shape as desired such as circular or oval. Thus, in the above embodiments, an actuation portion of the desired shape may be provided by an upstand on the top wall of the button arranged to project through the opening in the case.

The base plate may be of rectangular or other suitable shape and/or the opening(s) may be of circular or other suitable shape as desired for a given application.

The base plate may have a plurality of guide posts or other suitable guide means associated with each opening for axially locating the push button(s) with optional co-operating formations for retaining the push button(s) in a raised position under the biassing of the associated membrane. Where the base plate is provided with guide posts, the number and arrangement may be chosen to suit the size and shape of the opening(s) in the base plate and/or the recess in the button.

The base plate may be adapted for securing to the board or case by any suitable means. Where the base plate is provided with resilient legs, tongues or similar formations, the number and arrangement may be chosen to suit the size and shape of the base plate. The formations may retain the base plate by self-latching or friction engagement with the board or case as desired.

The membrane(s) may be permanently secured to the base plate by any suitable formations providing a mechanical key between the membrane(s) and the base plate. Alternatively, or additionally, moulding of the membrane(s) onto the base plate may be controlled so that the the membrane(s) bond to the base plate.

The key button structure may be arranged for actuation of any suitable switch device aligned with the hole(s) in the base plate and the invention is not limited to the exemplary switch device above-described.

It will be appreciated that the integral spring unit formed by the base plate and membrane(s) has advantages for manufacture of keyboards incorporating the invented key button structure. Thus, the number of separate components for assembly is reduced and a common spring unit may be used with different push button(s). Where provided, the internal guide means positively locates the push button throughout its travel and enables the overall height to be reduced to a minimum producing a compact assembly suitable for a wide range of applications with optional retention of the push button(s) on the guide means providing further assembly benefits.

Other benefits and adavantages of the invention will be apparent to those skilled in the art and the invention is deemed to include all modifications and variations within the scope of the appendant claims.

Claims

1. A key button structure for a switch assembly characterised by a base plate (1;101) having an opening (5;105) defining a switch site, and a resiliently flexible membrane (2;102) integral with the base plate (1;101) and arranged to provide a return spring function for a push button (3;103).

2. A key button structure according to Claim 1 characterised in that the base plate (1;101) has guide means (6;106) for locating a push button (3;103) for axial sliding movement towards and away from the base plate (1;101).

3. A key button structure according to Claim 2 characterised in that the push button (3;103) has retainer means (15;115) engageable, preferably releasably, with the guide means (6;106) to retain the push button (3;103) in a raised inoperative or rest position under the biassing of the membrane (2;102).

4. A key button structure according to Claim 2 or Claim 3 characterised in that the guide means (6;106) comprises guide posts (6;106) received in a recess (13;113) in the push button (3;103) with outer corner edges (6a;106a) engaging adjoining sidewalls (12;112) of the recess (13;113).

5. A key button structure according to any one of the preceding Claims characterised in that the base plate (1;101) has integral attachment means (4;29;136) for securing to a carrier (21;28;128).

6. A key button structure according to Claim 5 characterised in that the attachment means comprise a plurality of resilient formations (4;29) that are preferably self-latching and/or releasable.

7. A key button structure according to any one of the preceding Claims characterised in that the membrane (2;102) has a base (7;107) for sealing around the opening (5;105) on the underside of

the base plate (1;101) and a raised platform (8;108) on the opposite side of the base plate (1;101) with the platform (8;108) being depressible by a push button (3;103) for actuating a switch (25,26;125,126) aligned with the opening (5;105) in the base plate (1;101).

8. A key button structure according to any one of the preceding Claims characterised in that the base plate (101) has a plurality of openings (105) defining switch sites for a plurality of push buttons (103), and each opening (105) has a respective resiliently flexible membrane (102) integral with the base plate (101) to provide a return spring function for a push button (103).

9. A key button structure for a push button switch for a keyboard of a data input device characterised by a base plate (1;101) having an opening (5;105) defining a switch site, guide means (6;106) integral with the base plate (1;101) and extending to one side thereof around the marginal edge of the opening (5;105), a push button (3;103) located and retained on the guide means (6;106) for axial sliding movement towards and away from the opening (5;105), a resiliently flexible membrane (2;102) integral with the base plate (1;101) and biassing the push button (3;103) to a raised inoperative position, and the base plate (1;101) having integral attachment means (4;29;136) for securing to a carrier (21;28;128).

10. A key button structure according to Claim 9 characterised in that the base plate (101) has a plurality of openings (105) defining a plurality of switch sites for a plurality of push buttons (103).

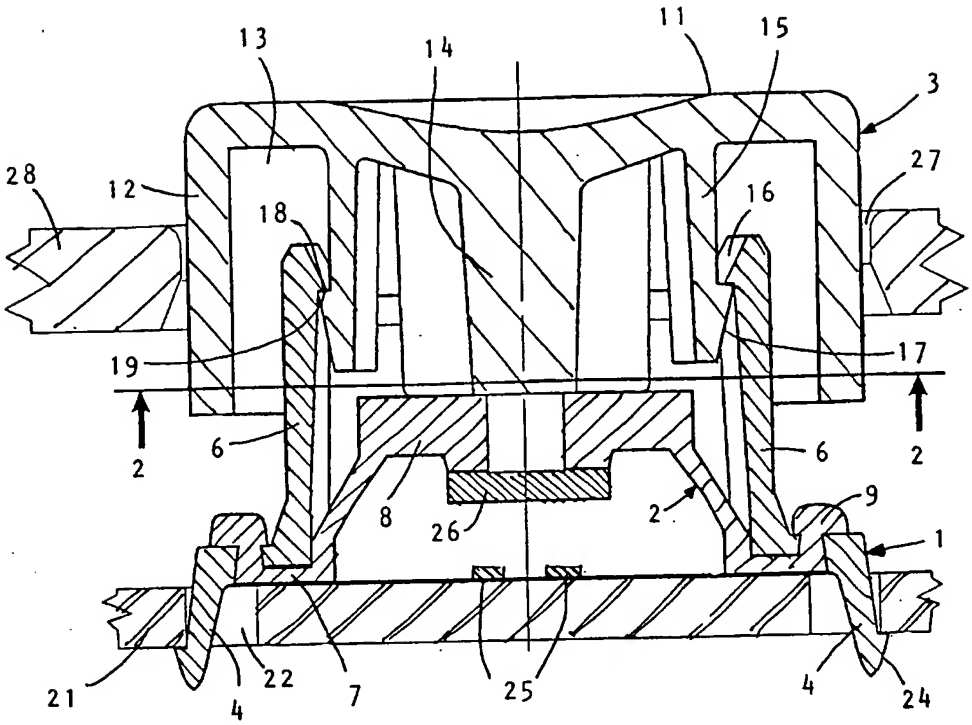

FIGURE 1.

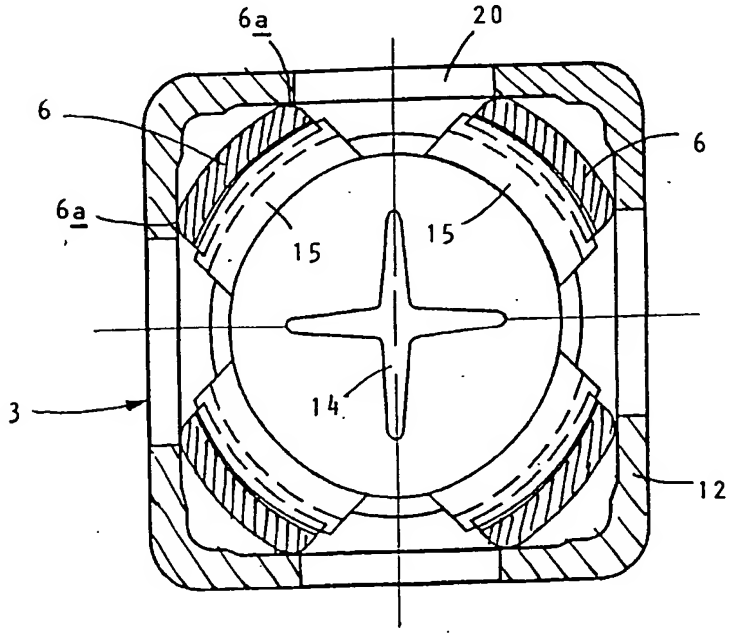

FIGURE 2.

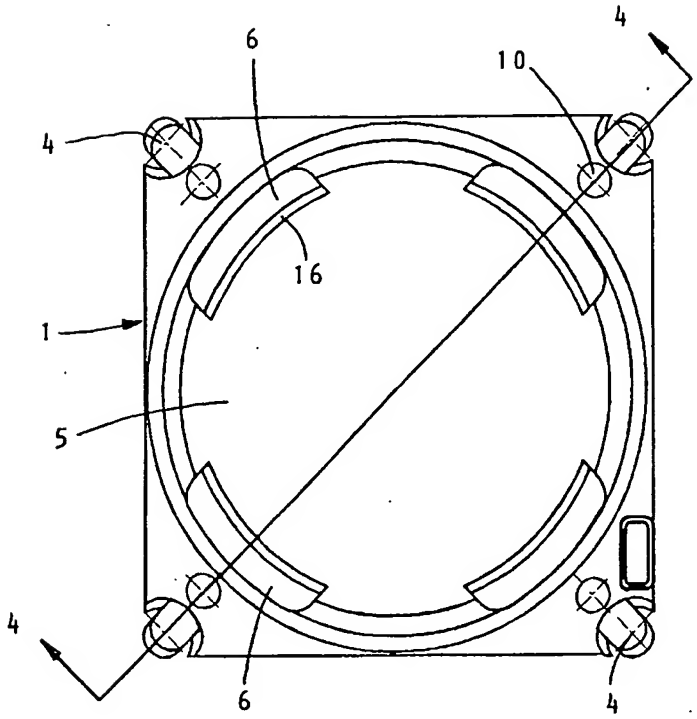

FIGURE 3.

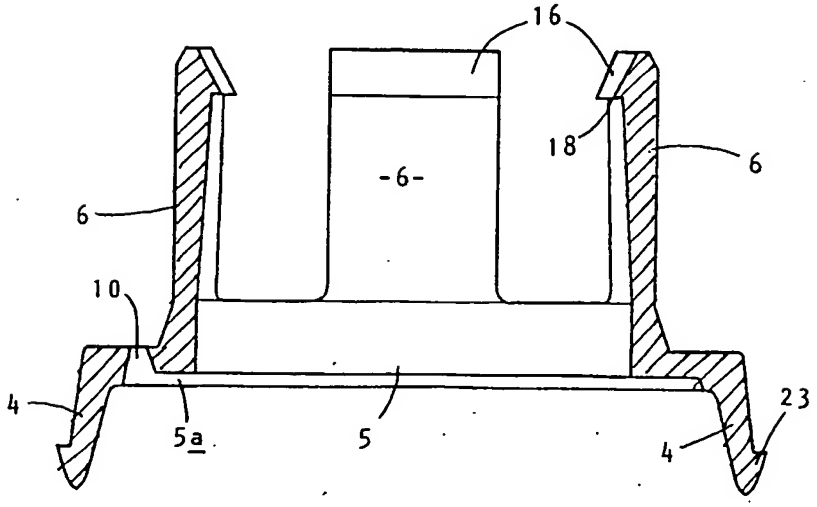

FIGURE 4.

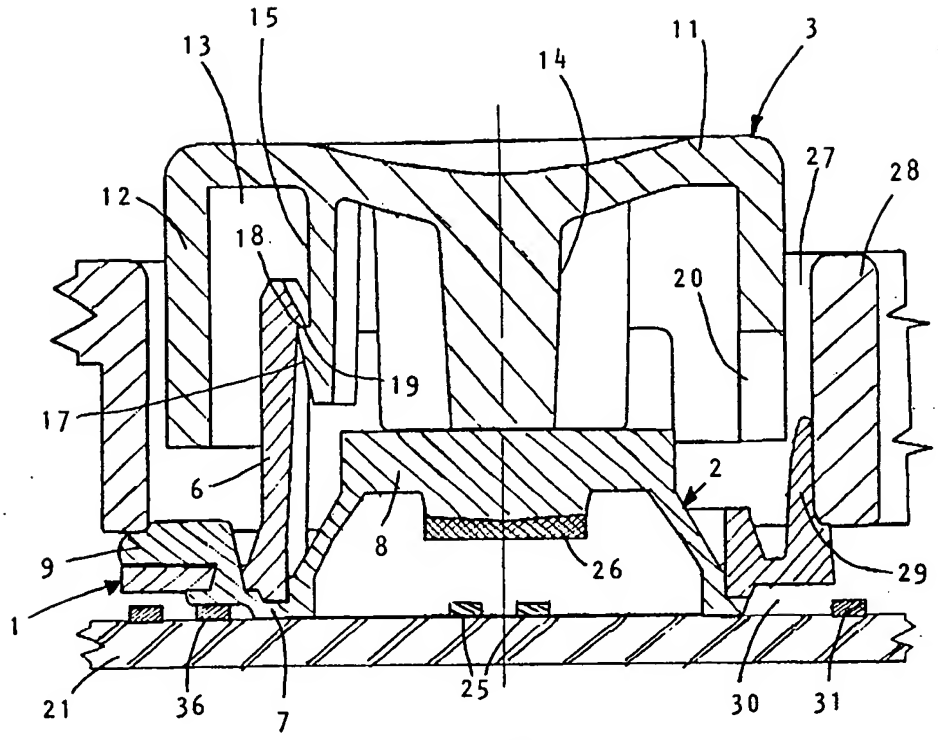

FIGURE 5

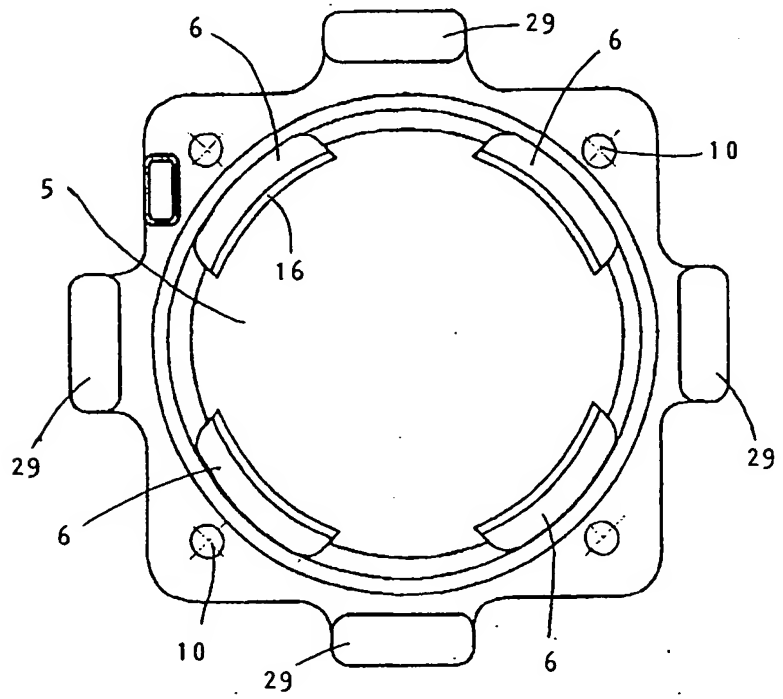

FIGURE 6

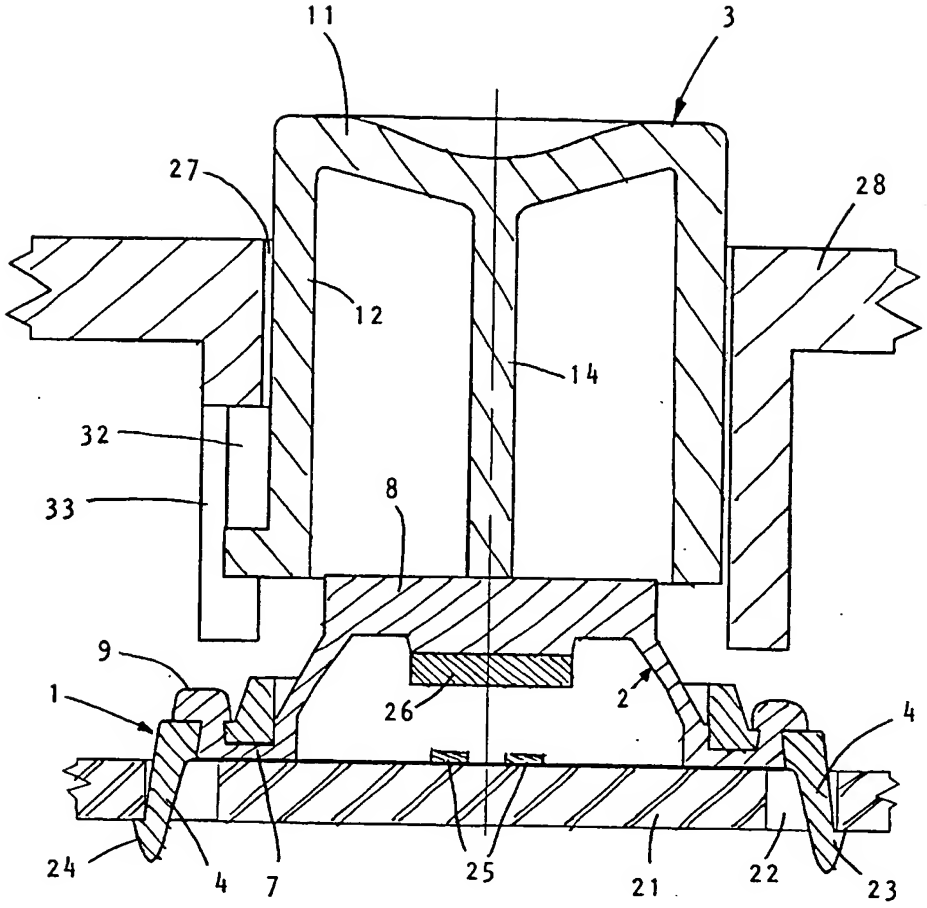

FIGURE 7.

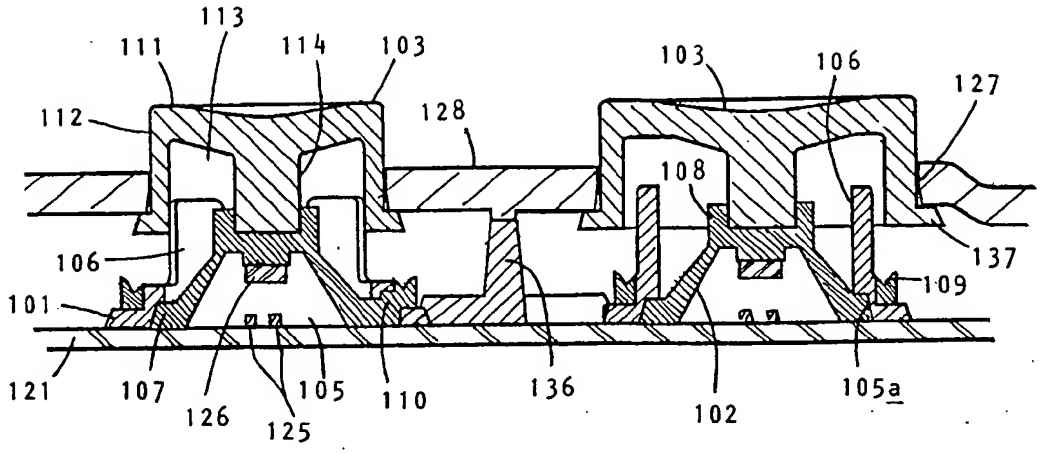

FIGURE 8.

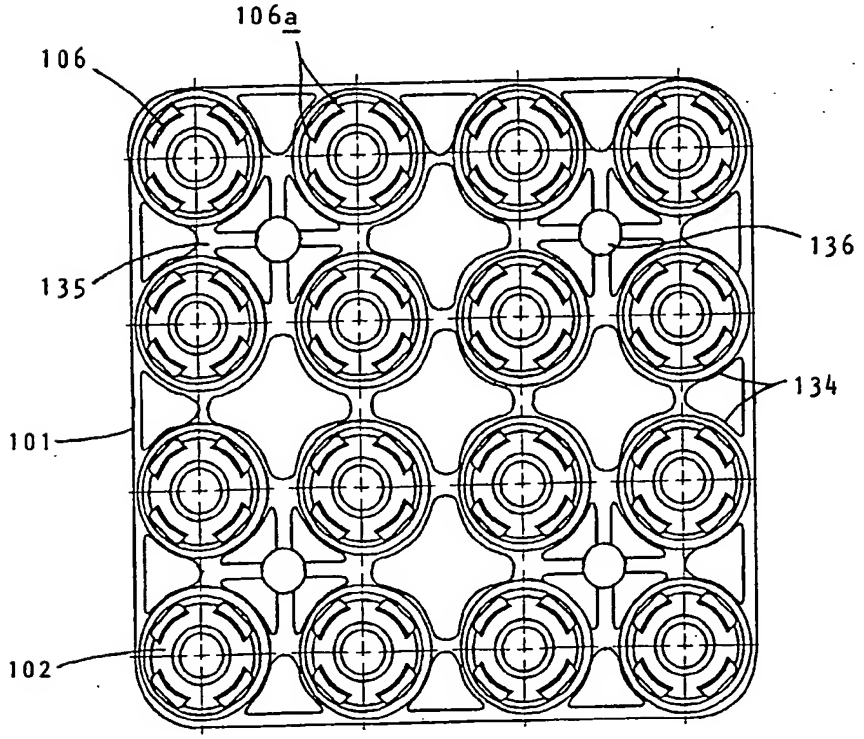

FIGURE 9.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 1242

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 144 916 (SIEMENS AG) * the whole document *	1,2,5-7	H01H13/70 H01H13/14
A		3,8-10	

X	EP-A-0 204 223 (SIEMENS AG) * column 3, line 4 - line 49; figure 1 *	1,5-7	
A		2,8-10	

X	EP-A-0 051 749 (PREH,ELEKTROFEINMECHANISCHE WERKE JAKOB PREH NACHF. GMBH & CO) * page 4, line 28 - page 6, line 18; figure 2 *	1	
A		3,7-10	

A	EP-A-0 110 094 (WILHELM RUF KG) * the whole document *	1-10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	19 MAY 1993	RUPPERT W.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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